Biological Monitoring Manual

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Introduction
There are many forms of life within a stream. From tiny mayfly larvae to the large white-tailed deer that use the stream for water, life abounds within and around a healthy stream system. In assessing your stream's condition, certain species lend themselves to telling us something about the health of a stream.

Scientific studies of natural **ecosystems** often use **indicator species** as a type of "environmental thermometer." Because some plants and animals are intolerant to pollutants or other negative environmental conditions, their presence can indicate a great deal about the health of the water they live in.

Assessment of the biological community requires little expense or labor to gather information, is relatively easy to analyze, and allows you to assess environmental conditions over a number of years.

Benthic Macroinvertebrates
Benthic macroinvertebrate monitoring is the most common method of assessing the biological health of a stream. As water conditions change, the benthic macroinvertebrate community that lives there changes too. The number and kinds of critters you collect and identify are relatively good indicators of stream health. Having an abundance of different types of critters, or high **biodiversity**, is important. Benthic macroinvertebrates are assessed because they are stable in their range (they don't travel long distances), are easy to collect and identify, and much is known of their tolerance levels to different pollutants.

Tolerance Groups
Perhaps one of the most important things that makes sampling for benthic macroinvertebrates so useful is the amount of information available on different families and their tolerance to different pollutants. Based on their sensitivity to pollution and/or habitat degradation, macroinvertebrates can be classified into three categories:

- Pollution Intolerant (high quality) – Because of their inability to survive in the presence of pollution and/or habitat degradation, the presence of organisms in this group generally indicate a healthy stream with good/stable water quality.
- Somewhat Pollution Tolerant (middle quality) – Organisms in this group can withstand some degree of pollution and/or habitat degradation but cannot survive very poor conditions.
- Pollution Tolerant (low quality) – Organisms in this group can survive in very poor conditions, with many of them having special adaptations that allow for their survival. Organisms such as the mosquito larvae, pouch snail, and rat-tailed maggot, for example, can live in waters with no dissolved oxygen because they breathe oxygen from the air, not from the water.

PLEASE NOTE: It is important to remember that these are general groupings of invertebrates. Finding a species from the pollution tolerant (low quality) group does not automatically indicate a dirty stream. Pollution tolerant organisms have the ability to live anywhere, and therefore can (and should) be found in areas with high water quality. However, if these are the only types of organisms found (i.e., there are no pollution intolerant or somewhat pollution tolerant organisms found), and you find substantial populations of them, this may be indicative of a poor quality stream.

Index Period
A ***<u>maximum of three</u>*** macroinvertebrate samples should be collected each year. More frequent sampling may impact the populations of macroinvertebrates that you are collecting. If you are monitoring a stream of exceptionally high quality, it is recommended that you limit collecting to no more than thirty minutes.

Macroinvertebrate samples should be collected between mid-April and mid-November with at least one sample being collected from mid-July through mid-October. The time of year that you collect your sample will influence what you find in that sample due to the different life cycles for different macroinvertebrates.

Biological Sampling Tips

This section aims to give you tips on sampling some of the habitats and microhabitats that you may find in your stream reach. Below are suggestions on what equipment to use and how to sample the different macro- and microhabitat types to gather macroinvertebrates most effectively. These suggestions are based on what has been successful for IOWATER staff and volunteers in the past, and techniques used by professionals in the field. You should sample all of the different large and small habitats that are safely and legally accessible within your stream reach.

Macrohabitat Sampling Methods

Riffles

Using Your Net - One of the most effective ways to sample a riffle is to do the “benthic shuffle.” To do this, place your net in the water so that the frame of the net is pressed firmly against the bottom of the stream. Standing just upstream of the net, begin to shuffle your feet while you move toward the net, making sure to kick and rub your feet around rocks. The general idea is to move the substrate around in order to dislodge organisms so that they are carried by the stream flow into your net. To put it in dancing terms, you are shaking a leg in order to shake the critters loose. After a few minutes of disturbing the stream bottom, bring the net up out of the water and inspect for organisms.

Using Your Sieve - Another common method is to pick up rocks in the riffle, turn them over, set them in your sieve and pick macroinvertebrates off of the rocks with your forceps. You may also use your sieve as a scoop to collect substrate and sift through to locate any captured invertebrates.

Riffles can contain a number of different microhabitats, the most common of which include: rocks, leaf packs, fallen trees, logjams, algae mats, and junk. Refer to the microhabitat sampling methods section below to sample all of the different microhabitats found.

Runs

There really is no single preferred method used to sample runs, but if possible, you will want to sample all microhabitats found in your run. How you sample your run will depend on the types of microhabitats you find. All of the microhabitats listed below can be found in a run. Refer to the microhabitat sampling methods section below to sample microhabitats found in your run.

Pools

Pools can be relatively deep areas of your stream that may limit how you can sample them. One method is to use your net and drag it across the bottom to try to dislodge or pick up the substrate. You will want to be careful, however, not to collect too much sand, mud, or other substrate as it may be difficult (and heavy) to sift through. You may find it beneficial to use your net to collect the substrate and then transfer it to your sieve to sift through it. Microhabitats that you can expect to find in pools include: root wads, fallen trees, silt/muck, sand, overhanging vegetation, leaf packs, undercut banks, rip rap, and junk.

Microhabitat Sampling Methods
Some methods for sampling microhabitats are discussed below. The main idea with all microhabitat sampling methods is to agitate the microhabitats sufficiently enough to dislodge any organisms that may be residing in them.

Algae Mats
Using your sieve and/or net, start at the downstream end of the algae mat and, using short, choppy jerking motions, move your sieve/net upstream through the algae mat. Lift the sieve or net out of the water and pick apart any algae strands to try to locate macroinvertebrates.

Logjams and Fallen Trees
To sample logjams and/or fallen trees, try to rotate the logs and branches so that you can see the parts of them that were submerged in the water. If you can rotate the logs, look at the submerged portion and pick macroinvertebrates off using your forceps. NOTE: Act quickly as many organisms will try to hide in cracks/crevices once the log is exposed to air.

If you can't rotate the logs or branches, try to run your sieve or net along the underside of them, scraping the sieve or net frame against the logs, branches, and leaves as you go. Depending on their size, it may also be possible to place your net downstream of the logjams and fallen trees and shake them vigorously to dislodge organisms. Additionally, you may also run your hands and/or feet along and around the logs, branches and trees in hopes of dislodging organisms.

Logjams can also be great places to find other microhabitats such as leaf packs or junk.

Root Wads
Root wads can be difficult to sample. Using short, choppy jerking motions, try to run your sieve or net across the underwater portion of the root wad, moving the sieve back and forth trying to scrape organisms off the roots. Depending on its size, it may also be possible to place your net downstream of the root wad and shake the root wad vigorously to dislodge organisms. Additionally, you may also run your hands and/or feet along and around in the root wad in hopes of dislodging organisms.

Silt/Muck and Sand
To sample silt/muck and/or sand, use your sieve or net and scrape the substrate from the bottom of the stream or lake. When you have some silt/muck and/or sand in your sieve or net, lower the sieve/net into the water, but do not submerge the top of the sieve or the frame of the net. Move the sieve or net back and forth while using your fingertips to agitate and clean the sample. This will rinse some of the substrate through the pores and will help you to see any macroinvertebrates that remain.

Additionally, look for tiny tracks/paths in the sand, silt, and muck. Some dragonfly larvae, for example, burrow through sand and create paths that may be visible on the surface of the substrate. Poking around at one end or the other of these paths will often render results.

Overhanging Vegetation
Overhanging vegetation can be sampled by lowering your net or sieve into the water below the vegetation. Using short, choppy jerking motions, bring your net or sieve up through the vegetation while moving the net or sieve back and forth to dislodge organisms. In streams, you will want to work though vegetation on the downstream side, allowing the stream flow to deliver dislodged critters to your net or sieve.

Leaf Packs
The easiest way to sample leaf packs is to pick them up, place them in your sieve and pull apart the individual leaves. It may also be helpful to submerge the lower portion of the sieve or net so you can use the water to move the debris around and dislodge organisms.

Rocks, Rip Rap and Junk (tires, garbage, etc.)
Individual rocks, pieces of rip rap, or junk, if small enough, can be picked up and inspected. Many organisms, while being adapted to life in moving water, will likely be found on the downstream or bottom side of these microhabitats in cracks, crevices and holes. Macroinvertebrates can then be removed with your forceps. To avoid losing organisms, these microhabitats should be inspected over (or in) your net or sieve so that any benthics that fall off may be recovered. If there is a large area of rocks, such as in a riffle, the "benthic shuffle" can be done (see "Riffles" section above).

For large pieces of rip rap and/or junk, you may try to use your sieve, net or forceps to sample in the space between pieces, using short, choppy jerking motions to dislodge critters.

Weed Beds/Aquatic Vegetation
Sampling weed beds is similar to sampling algae mats or overhanging vegetation. Using short, choppy jerking motions, start at the downstream side of the weed bed and drag your net or sieve through the weed bed moving back and forth to dislodge macroinvertebrates.

Undercut Banks
To sample undercut banks, use your sieve or net and, using short, choppy jerking motions, drag it along the surface where the water meets the bank.

Other
Don't be afraid to use your net, sieve, or hands to sample any other place you think a macroinvertebrate might live. Remember to do only what is safe and what works best for you!

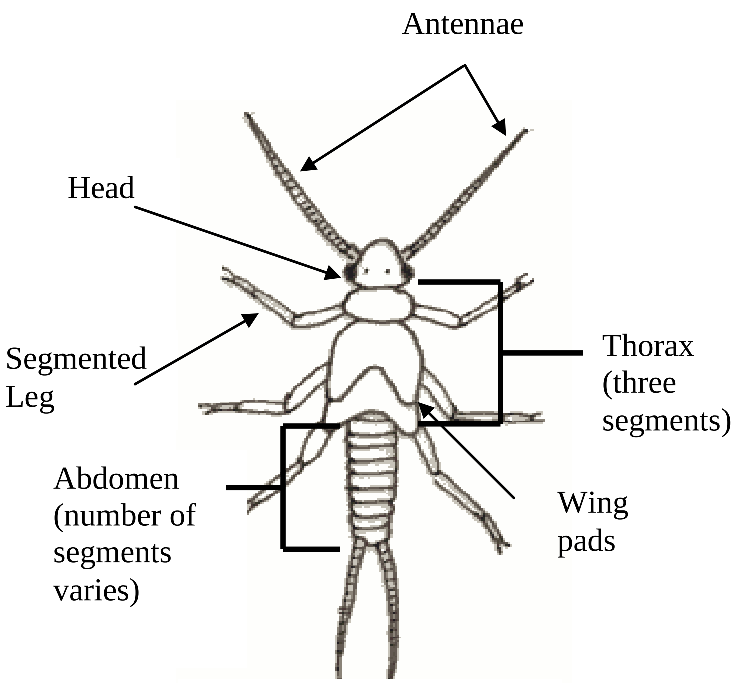
Benthic Macroinvertebrate Identification

Classification

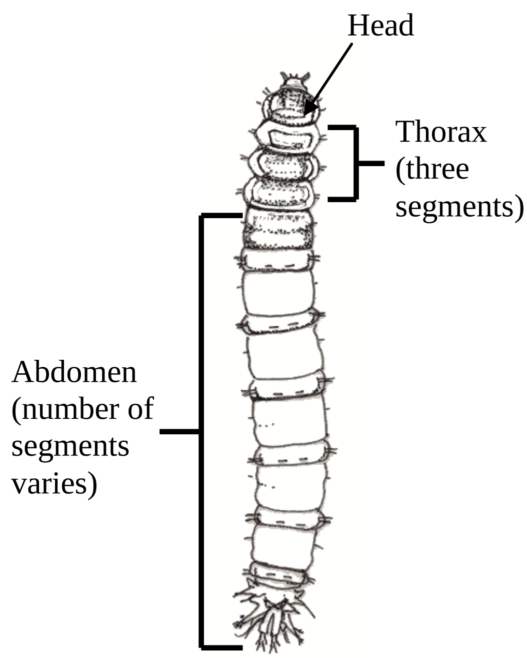
In order to effectively study living things, scientists had to develop a classification system that would enable them to not only name organisms (using scientific names rather than common names), but also to show their relationship to other living things. This classification system, which was developed in 1757 by Swedish botanist Carl Linnaeaus, classifies organisms into a hierarchy (Kingdom, Phylum, Class, Order, Family, Genus, Species), which organizes organisms based on similar characteristics. You will identify most of the invertebrates you find to the Class, Order, or Family categories through the IOWATER program.

Kingdom - Anamalia				
Phylum	**Subphylum**	**Class**	**Order**	**Family**
Arthropoda	Crustacea	Malacostraca	Decapoda (*crayfish*)	
			Isopoda (*sowbug*)	
			Amphipoda (*scud*)	
	Chelicerata	Arachnida (*water mite*)		
	Hexapoda	Insecta	Trichoptera (*caddisfly*)	
			Odonata (*dragonfly & damselfly*)	
			Diptera (*true flies*)	Chironomidae (*midge fly*)
				Culicidae (*mosquito*)
				Simuliida (*black fly*)
				Syrphidae (*rat-tailed maggot*)
				Tipulidae (*crane fly*)
			Ephemeroptera (*mayfly*)	
			Coleoptera (*water beetles*)	Dytiscidae (*predacious diving beetle*)
				Elmidae (*riffle beetle*)
				Gyrinidae (*whirligig beetle*)
				Haliplidae (*crawling water beetle*)
				Hydrophilidae (*water scavenger beetle*)
				Psephenidae (*water penny beetle*)
			Hemiptera (*true bugs*)	Belostomatidae (*giant water bug*)
				Corixidae (*water boatman*)
				Nepidae (*water scorpion*)
				Notonectidae (*backswimmer*)
				Gerridae and Veliidae (*water strider*)
			Megaloptera	Corydalidae (*dobsonfy*)
				Sialidae (*alderfly*)
			Plecoptera (*stonefly*)	
Annelida		Oligochaeta (*earthworm*)		
		Hirudinea (*leech*)		
Mollusca		Bivalvia (*mussel & clam*)		
		Gastropoda (*snails)*		
Platyhelminthes		Tubellaria (*flatworm*)		

Morphology
In order to effectively identify benthic macroinvertebrates, it is important to recognize distinct features or key characteristics of each group. Due to their large diversity, most identification efforts will be spent on the insects. It is first helpful to understand some of the structures that will be referred to when you start identifying different types of insects. Some of the common structures of insects are below.



Typical aquatic insect larva



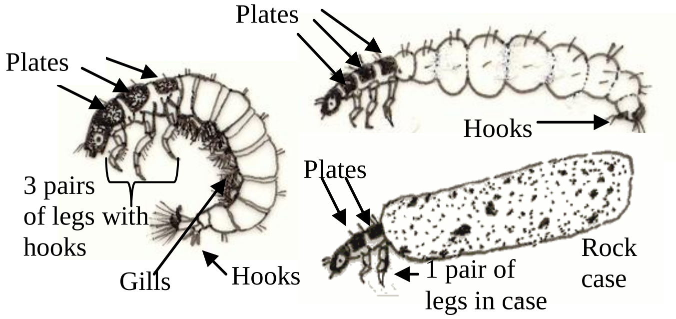
Typical true fly larva

Websites to visit for Identification help
University of Iowa Hygienic Lab Limnology:
http://www.uhl.uiowa.edu/services/limnology/macroinvertebrates/index.xml
BugGuide (A Nationwide Online Community that can provide identification help):
http://bugguide.net/node/view/15740
Visit: http://www.iowater.net/Links/Links.htm#Benthic for a list of additional resources.

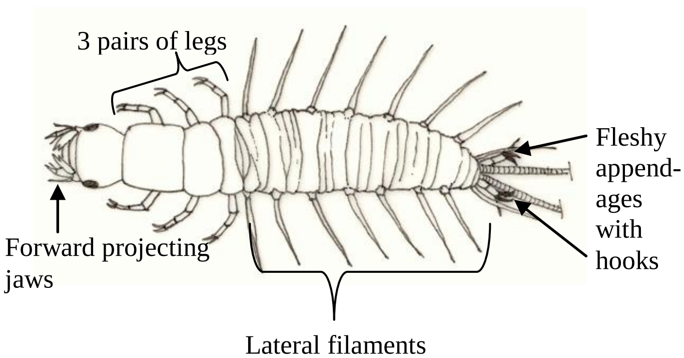
Note on Identification help: IOWATER staff can help you identify benthic macroinvertebrates that you are having trouble with. Please email a clear, high-quality digital photo to iowater@iowater.net along with a description of where it was caught and any features that stand out to you. Contact IOWATER if you have questions.

Pollution Intolerant

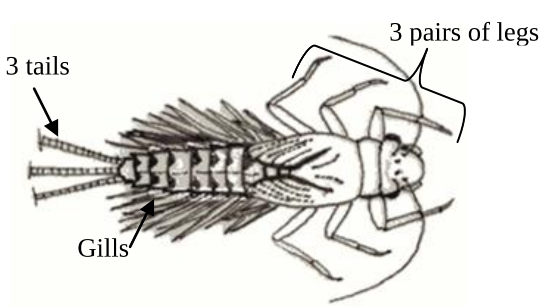
Caddisflies – 3 pairs of legs each terminating in a pair of hooks, head and thoracic segments (sometimes only the 1st segment) covered in hard plates and a soft abdomen that ends in a pair of prolegs bearing hooks. Sometimes builds stick, rock or leaf case.



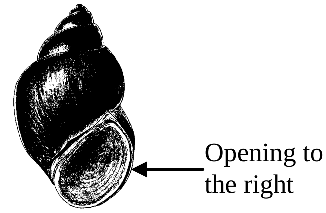
Dobsonflies – 3 pairs of legs, 8 pairs of lateral filaments on abdomen, and large forward projecting jaws. The end of the abdomen has a final set of lateral filaments and a pair of fleshy appendages; each bears a pair of hooks.



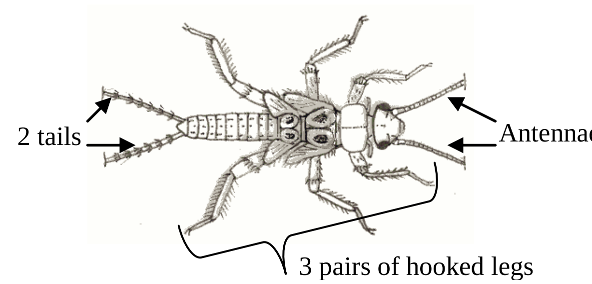
Mayflies – 3 pairs of legs, feather or oval-shaped gills on their abdomen and 2 to 3 long tails.



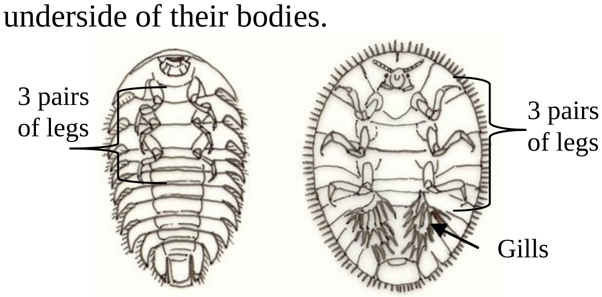
Right spiral snail – Shell opening spiraling up from the right if you look at the shell with the tip up and the opening facing you. Do not count empty shells.



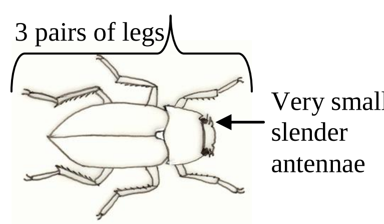
Stoneflies –3 pairs of hooked legs, antennae, 2 tails and gill tuffs under their legs ("hairy armpits") or no visible gills.



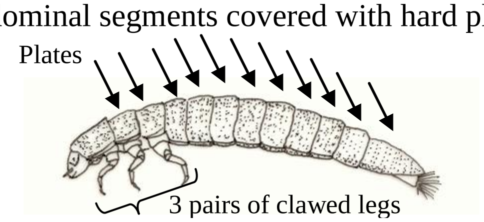
Water Penny Beetles – Flat and saucer-shaped. They have 3 pairs of tiny legs and gills on the underside of their bodies.



Riffle Beetles (Adult) – 3 pairs of long legs, slender antennae, and walks slowly under water.

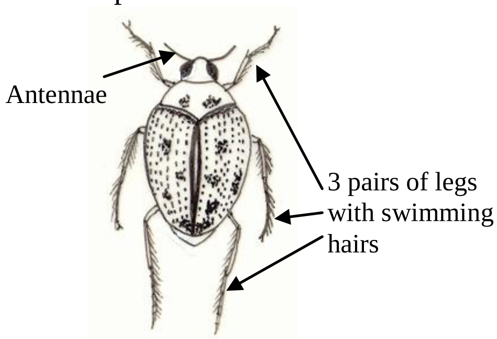


Riffle Beetles (Larva) – 3 pairs of legs terminating in a single claw, thoracic and abdominal segments covered with hard plates.

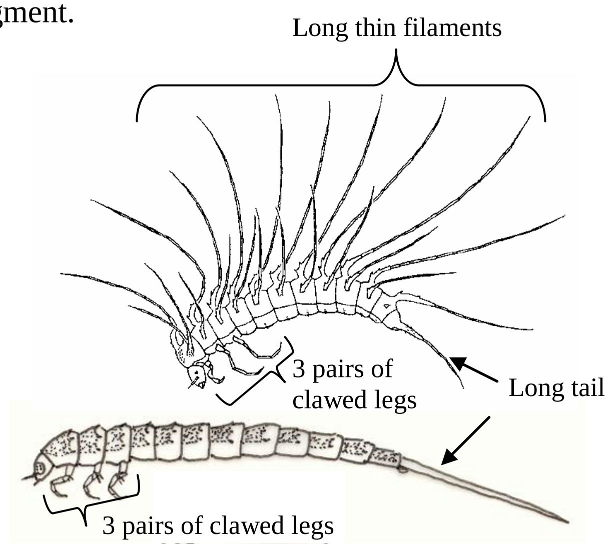


Somewhat Pollution Tolerant

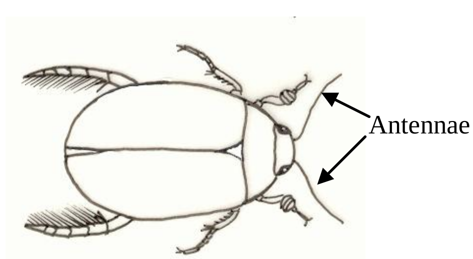
Crawling Water Beetles (Adult) – long, slender antennae, swimming hairs on 3 pairs of legs and is often patterned or spotted.



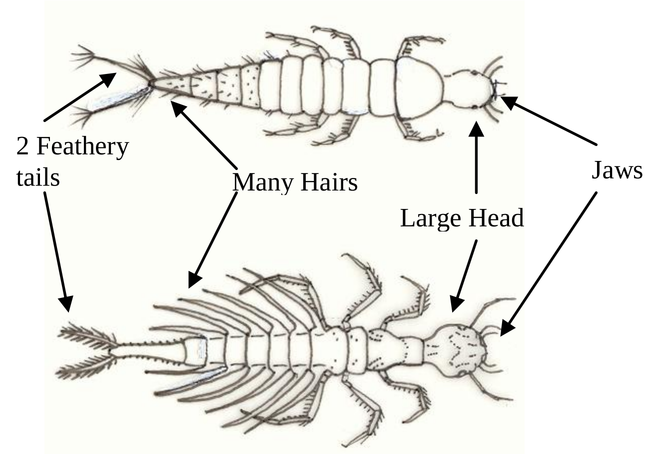
Crawling Water Beetles (Larva) – 3 pairs of legs each ending in hook-like claws, one long tail, and sometimes with long thin filaments extending dorsally from each thoracic and abdominal segment.



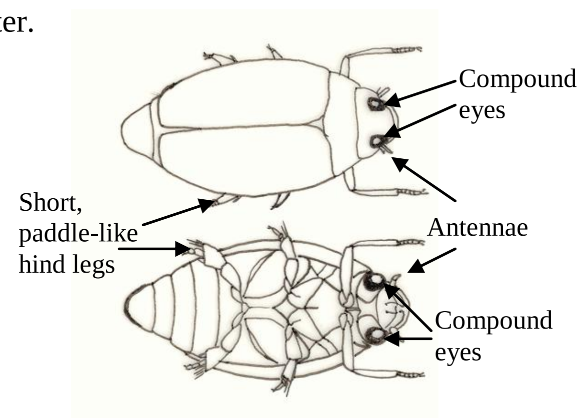
Predaceous Diving Beetles (Adult) – Oval streamlined body, antennae longer than Whirligig Beetle's and slender.



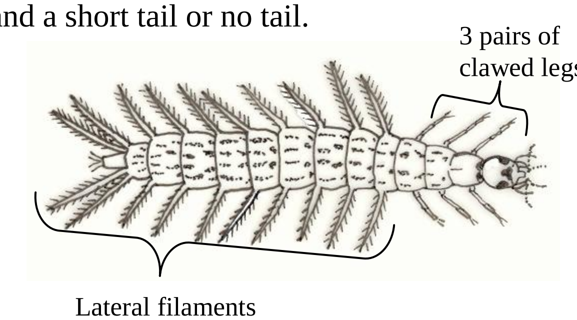
Predaceous Diving Beetles (Larva) – Many hairs on body (sometimes very short), two feathery tails and a large head and jaws.



Whirligig Beetles (Adult) – Oval body, short clubbed antennae and mid and hind legs that are short and paddle-like. They have compound eyes that are divided so that it appears that they have eyes on the top and bottom of their bodies. They are erratic swimmers often on the surface of the water.

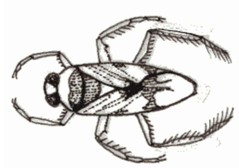


Whirligig Beetles (Larva) – 3 pairs of clawed legs, 10 abdominal segments with lateral filaments and a short tail or no tail.

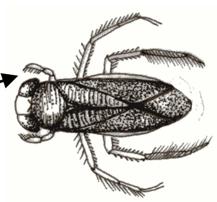


Somewhat Pollution Tolerant Continued

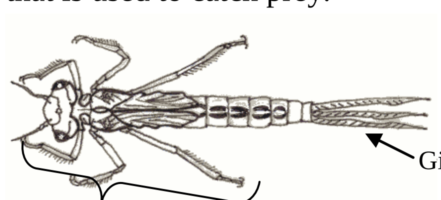
Backswimmers – Forelegs are not as spoon-shaped as the Water Boatmen and a v-shaped body. The backswimmer swims upside down; when it stops its legs will be pointing up.



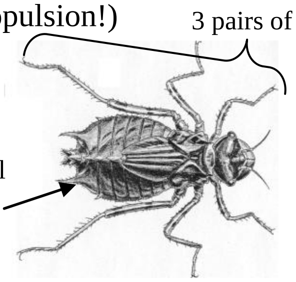
Water Boatman – Forelegs are spoon-shaped and shorter compared to the backswimmer.



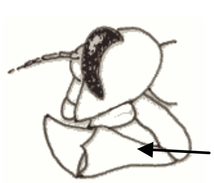
Damselflies – Are more slender than dragonflies. They have 3 pairs of thin hooked legs, large eyes and 3 broad oar-shaped “tails” (gills). Their lower lip forms an extendable mask-like or scoop-like feature that is used to catch prey.

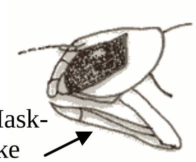


Dragonflies – Wide oval abdomen, 3 pairs of hooked legs and large eyes. Their lower lip forms an extendable mask-like or scoop-like feature that is used to catch prey. Dragonflies swim by taking in water with their mouths and shooting it out their anus (Jet-propulsion!)

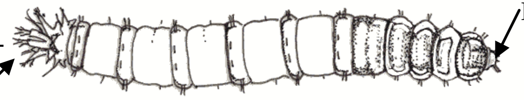


Damselflies & Dragonflies lower lip:

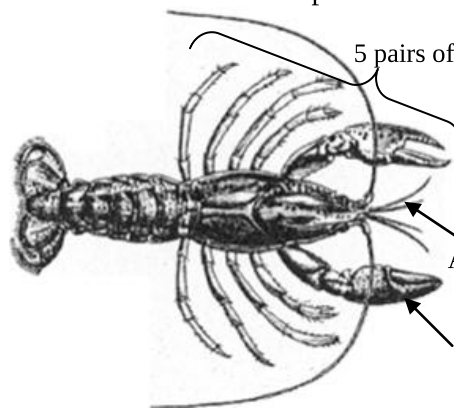




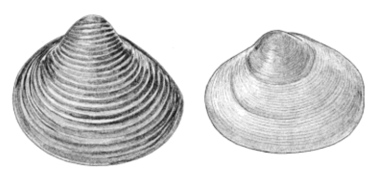
Crane Flies – Caterpillar-like segmented body with 4 finger-like lobes at the posterior of the abdomen and a head retracted into the body.



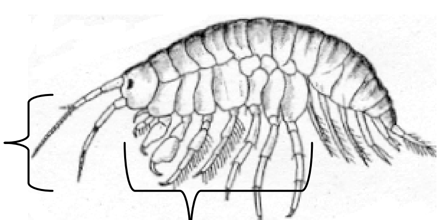
Crayfish - Look like small lobsters and have 5 pairs of legs with the front two bearing large claws, antennae and an exoskeleton composed of chitin.



Clams and mussels – Fleshy body enclosed between 2 clamped shells. Do not count empty shells.

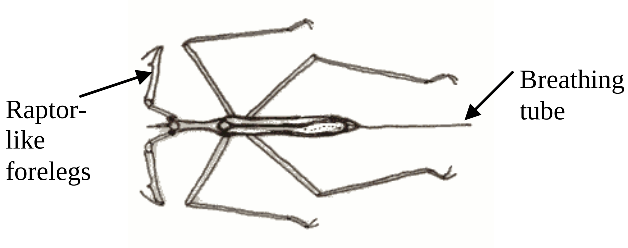


Scuds – Laterally compressed (body is higher than it is wide), white to pale yellow in color, and are good swimmers. They are also called “freshwater shrimp” (although there is no relation); scuds will be on their sides if removed from the water because of their body shape. They have seven pairs of legs, two pairs of antennae of equal length, and an exoskeleton composed of chitin.

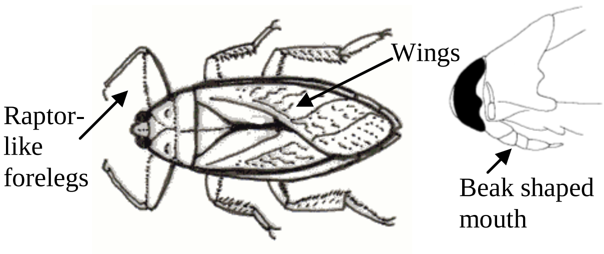


Somewhat Pollution Tolerant Continued

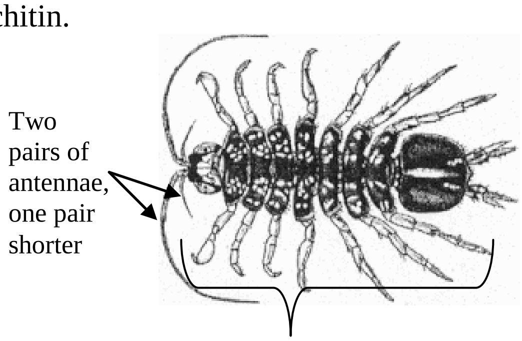
Water Scorpions – Raptor-like forelegs for catching prey, a long stick-like body and a long breathing tube extending from their abdomen.



Giant Water Bugs – Oval body, raptor-like forelegs for catching prey, a beak shaped mouth and leathery textured wings that fold across each other.

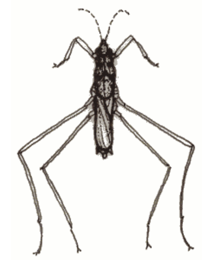


Sowbugs - Look similar to scuds except they are dorso-ventrally flattened (body is wider than it is high) and gray to brown in color. They have seven pairs of legs, two pairs of antennae (one pair shorter than the other), and an exoskeleton composed of chitin.

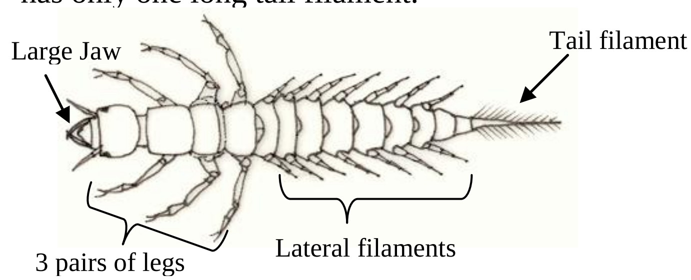


Orbsnails – Single coiled shell resembling the horns of a ram. Do not count empty shells.

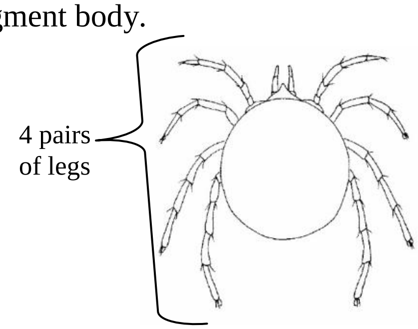
Water Striders – Slender body with long legs that allow them to "walk" on the water surface with a combination of surface tension, claws on their legs, and an excreted wax.



Alderflies – 3 pairs of legs, 7 pairs of lateral filaments on abdomen and large forward projecting jaws. Looks like a small dobsonfly but has only one long tail filament.



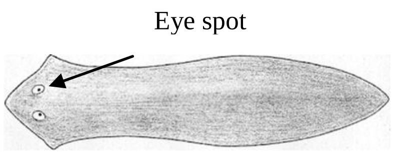
Water Mites - 8 legs, no antenna, and a round one segment body.



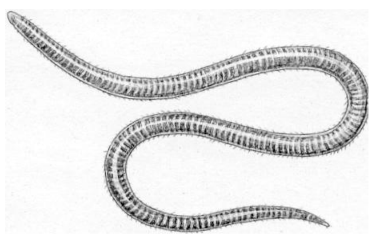
Limpets – Single uncoiled shell. Do not count empty shells.

Pollution Tolerant

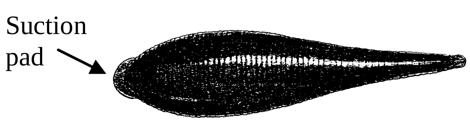
Flatworms - Small, flat, soft-bodied worms which often have a triangular or arrowhead-shaped head and visible eye spots.



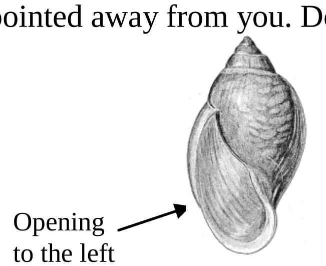
Aquatic worms - Look like earthworms you might find in your garden, although usually they are smaller, thinner, and more delicate. They are segmented.



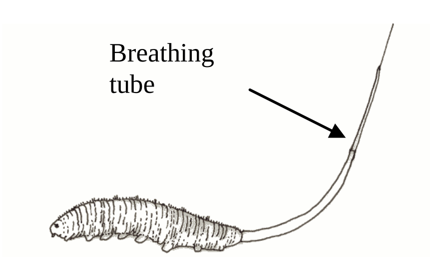
Leeches - Larger than aquatic worms, flattened, and usually have a suction pad on at least one end of their body. Usually brown but they can sometimes be brightly colored.



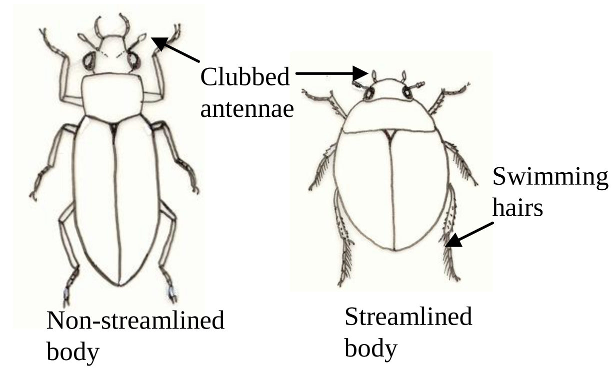
Left spiral snails (pouch snail) – Shell opening spiraling up from the left if you look at the shell with the tip pointed away from you. Do not count empty shells.



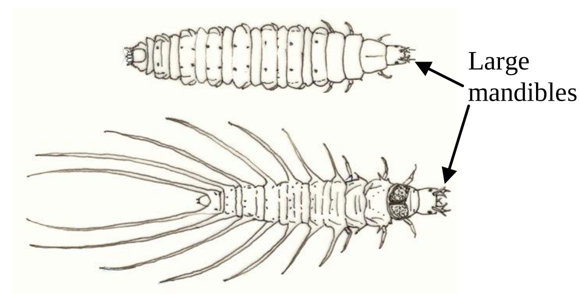
Rat-Tailed Maggots – Worm-like or grub-like body, semi-transparent skin and a long breathing tube.



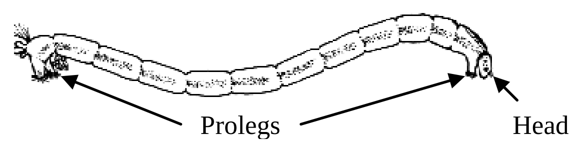
Water Scavenger Beetles (Adult) – Sometimes streamlined, few have swimming hairs on their legs and have short clubbed antennae.



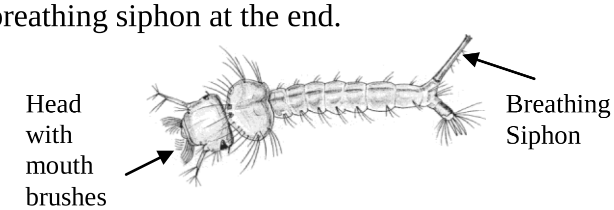
Water Scavenger Beetles (Larva) – Short antennae, soft bodies and large mandibles.



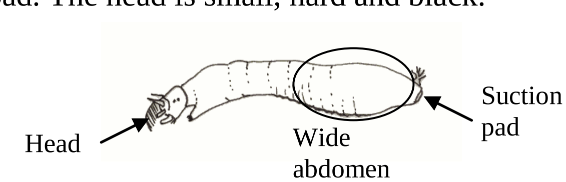
Midge Flies – Small worm-like bodies, with a hard usually dark head and 2 small prolegs on each end.



Mosquitoes – Wide head with small mouth brushes and short antennae. Its abdomen has a breathing siphon at the end.



Black Flies – The posterior of the abdomen is wider than the rest of the body and has a suction pad. The head is small, hard and black.



Other Life in Streams

Vertebrates refer to animals with backbones. This includes amphibians, reptiles, fish, birds, and mammals. Although they may be the most captivating members of a natural community, they are difficult to use as indicator species because of their ability to move great distances.

Fish are arguably the most recognized animals in our streams. Interest in sport fishing from catfish to trout leads hundreds of thousands of Iowans to the water each year. Fish can be used in assessing stream health, although collecting and identifying fish for this purpose is very difficult. Many species of fish are protected by the state and federal government, so their collection in Iowa requires permits from state and federal agencies. Therefore, fish will not be used as indicators for IOWATER.

Iowa NatureMapping is an environmental monitoring program similar in structure to IOWATER, but focused on wildlife. For more information, visit the Iowa NatureMapping website at: http://www.extension.iastate.edu/naturemapping/.

Aquatic plants include all those that grow in the water or wet soils. Aquatic plant communities can be dominated by a single species or by a variety of species. Drawbacks to using plants as environmental indicators include the fact that many are very difficult to identify and that there is not much information known about their tolerance to pollution. In general, aquatic plants are indicators of clean water and stable substrate. They provide habitat and stabilize substrate during high flow conditions. They also produce oxygen and remove contaminants from sediment via root absorption.

Algae are microscopic plants that live in water. There are many different species of algae. Algae are too small to accurately identify without a microscope. Algae are commonly found attached to rocks or other streambed substrates in slower moving water, but excess algae can be caused by too many nutrients from the watershed. Too much algae can lead to oxygen depletion and may cause harm to animals living there. Certain kinds of algae can cause odors or foul tastes, or even produce toxic by-products that are a concern for drinking water treatment facilities.

In the presence of raw sewage, gray algae (also known as sewage algae) can form. This is not algae, but rather large colonies of **filamentous** bacteria. In a stream, this may be a sign of severe fecal contamination. Do not wade in this stream! If you observe sewage algae in your stream, please contact IOWATER for assistance. If you can, please take a photo of the site.

Bacteria are very tiny organisms that fall under the heading of biological sampling. Some bacteria serve as indicators of certain types of pollution, such as sewage, while other bacteria indicate organic pollution, such as gasoline spills. In most cases, “indicator” bacteria are not dangerous to animals (including us), but their presence may indicate the presence of **pathogens** (disease-causing organisms). People can become ill by accidentally swallowing certain types of pathogens, such as certain strains of *E.coli*, Shigella, and some parasites.

The IOWATER program offers a bacteria monitoring workshop to any volunteer who has completed the introductory workshop. After completing a stream assessment, it is advised that all monitors wash with soap and hot water to minimize any risk of disease.

Aquatic Invasive Species in Iowa

Aquatic Invasive Species:

- Are **non-native** plants, animals, and pathogens.
- Live primarily in **water**.
- Thrive in their **new environment**.
- Cause economic **loss**, environmental **damage**, and **harm** to human health.

There are a number of aquatic invasive species found in Iowa. These aquatic invaders do not occur naturally in our lakes and rivers, and when transplanted into them, these invasive species can cause serious ecological and economic harm by displacing native plants and animals, damaging water resources, and interfering with water-based recreation.

The main way these invasive species spread between waterbodies is by hitching a ride with anglers, boaters, and other water recreationists on boats and equipment, on aquatic plants, and in water. If you leave a waterbody without taking precautions, you may inadvertently spread the invasive species from one waterbody to another.

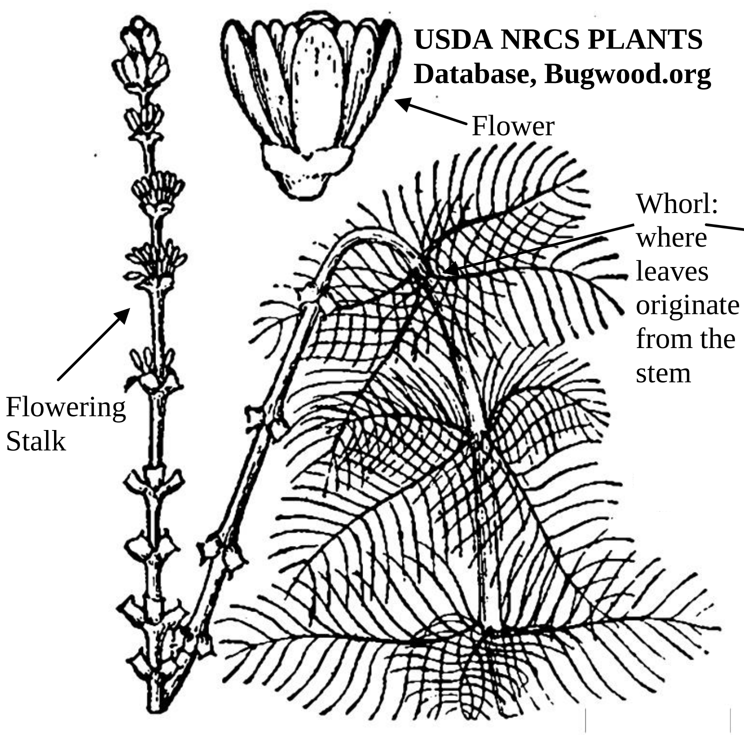
Fortunately, there are a few simple actions you can take to prevent their spread:

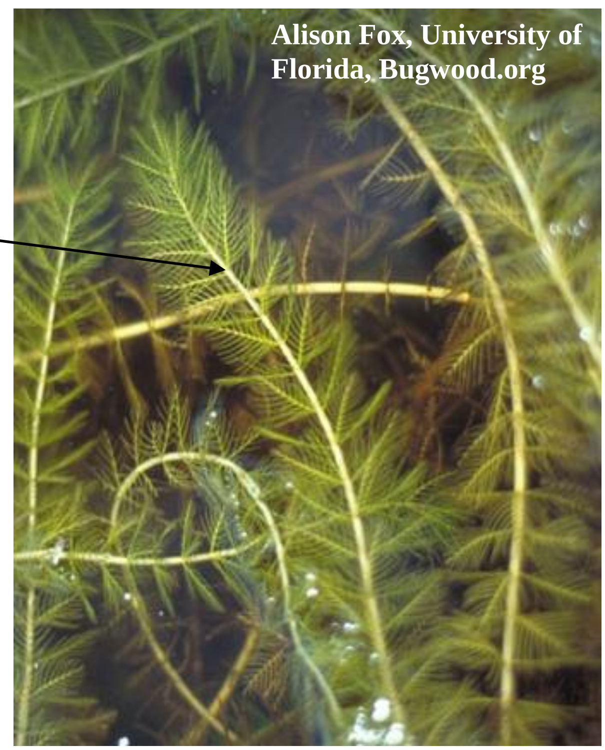
- Learn to identify aquatic nuisance species and report any suspected sightings to the nearest DNR fisheries station. Descriptions and pictures of some of the aquatic invasive species found in Iowa are discussed in this manual.
- Before leaving a waterbody:
  - Inspect your boat, trailer, and equipment and remove any visible plants, animals, or mud.
  - Drain water from your boat, motor, live well, and bilge before leaving a waterbody.
  - Dispose of unwanted bait in the trash.
- Never release fish, animals or plants into a waterbody unless they came from that waterbody.
- Rinse or dry your boat, trailer, and fishing equipment to remove or kill species that may not have been visible when you left a waterbody, and before using these things in another waterbody, rinse them with high pressure and/or hot water (at least 104 degrees) or allow them to dry for at least five days.

EURASIAN WATER MILFOIL

Eurasian water milfoil (*Myriophyllum spicatum)* is a submerged aquatic plant that is native to Europe, Asia, and northern Africa. It became established in 1992 in Crystal Lake in Hancock County. Eurasian water milfoil grows best in nutrient rich lakes in soft sediments. In these lakes, it can form thick underwater stands of tangled stems and vast mats of vegetation at the water's surface. In shallow areas, the plant can interfere with water recreation such as boating, fishing, and swimming. The plant's floating canopy can also crowd out important native water plants.

Eurasian water milfoil spreads easily in lakes because it has the ability to reproduce by stem fragmentation and underground runners. A single segment of stem and leaves can take root and form a new colony, so fragments clinging to boats, trailers, and other equipment can be spread from lake to lake. The mechanical clearing of weed beds for beaches, docks, and landings creates thousands of new stem fragments that can drift with the wind and current. Removal of native vegetation can also create the perfect habitat for Eurasian water milfoil to take hold and thrive.



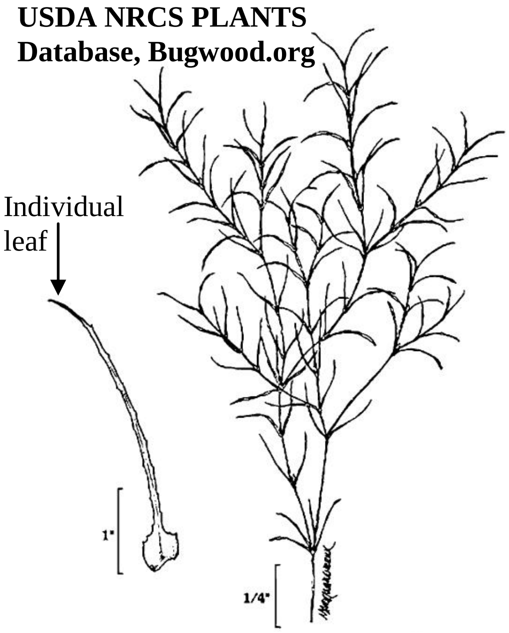


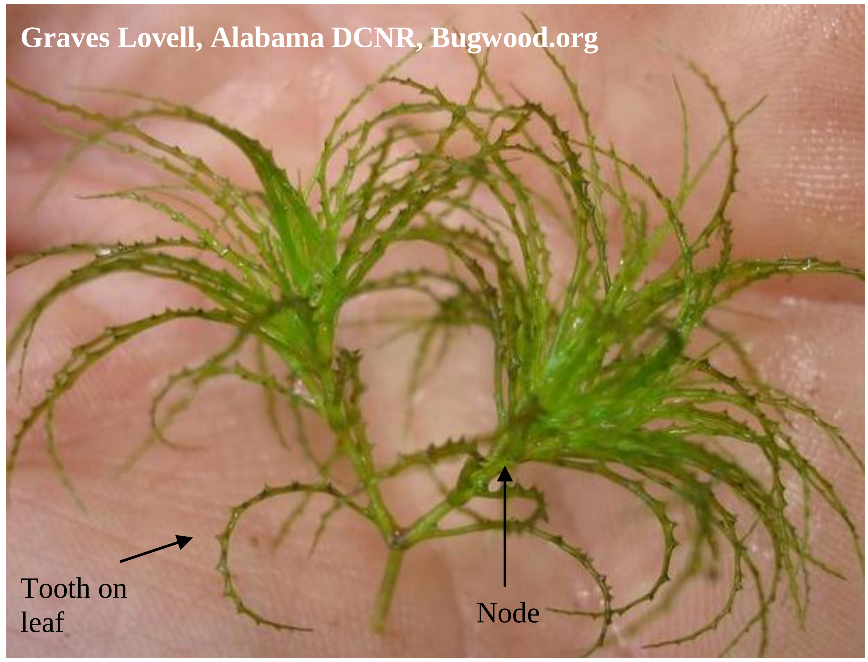
Key Characteristics of Eurasian Water Milfoil:

- Delicate feather-like leaves. Leaflets are mostly the same length.
- Leaves are usually limp when out of water.
- Leaves are arranged in whorls (circles) around the stem.
- Usually 12-21 leaflet pairs. (Native northern milfoil has 7-10 leaflet pairs.)
- Long spaghetti like stems.
- Eurasian water milfoil can also be confused with the native Coontail/hornwart. However, the leaves of Coontail are toothed and the plant feels rough when pulled through the hand, whereas Eurasian water-milfoil leaves are not toothed and the plant does not feel rough

BRITTLE NAIAD

Brittle naiad (*Najas minor*) is a submersed aquatic plant that is native to Europe. Brittle naiad can become a nuisance when it becomes overly abundant in some areas. Brittle naiad reproduces by fragmentation, and a single segment of stem and leaves can take root and form a new colony. Fragments clinging to boats and trailers can spread the plant from lake to lake. The mechanical clearing of weed beds for beaches, docks, and landings creates thousands of new stem fragments that can drift with the wind and current.





Key Characteristics of Brittle Naiad:

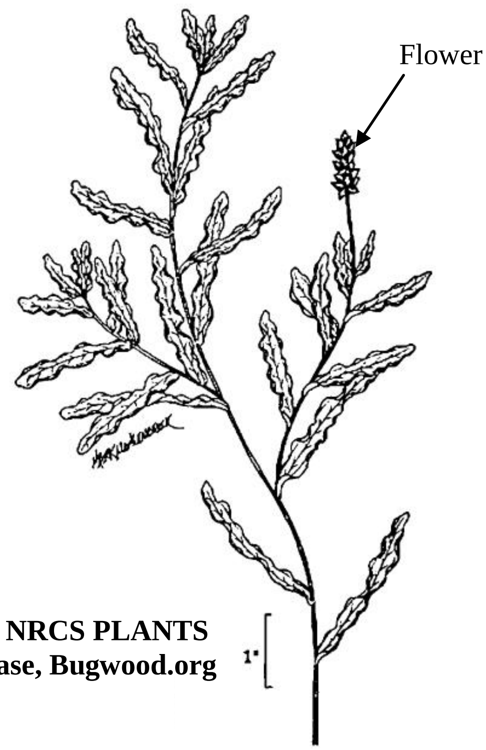
- Leaves are highly toothed (3 - 12 teeth).
- Leaves are up to 1 1/4 inch long and 3/16 wide with several leaves at each node.

CURLY-LEAF PONDWEED

Curly-leaf pondweed (*Potamageton crispus*) is a submerged aquatic plant that is native to Eurasia, Africa, and Australia. Curly-leaf pondweed is commonly found in alkaline and high nutrient waters, preferring soft substrate and shallow water depths. It can also tolerate low light and low water temperatures, which allows it to get a head start in the spring and out compete native plants. It can also form dense mats that make boating and other recreation difficult. Curly-leaf pondweed begins to die off in the mid-summer, which can create unpleasant, smelly conditions for people using the lake or pond. The die-off can also create low dissolved oxygen levels and lead to algae blooms when the nutrients from the plants are released.

Curly-leaf pondweed spreads through burr-like winter buds (turions), which are moved among waterways when they attach to boats, equipment, animals, etc. These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions.

Graves Lovell, Alabama DCNR, Bugwood.org



USDA NRCS PLANTS Database, Bugwood.org

Key Characteristics of Curly-Leaf Pondweed:

- Wavy appearance to the leaves.
- Leaves are finely toothed.
- Leaves are reddish green.
- Stems are reddish brown.

PURPLE LOOSESTRIFE

Purple Loosestrife (*Lythrum salicaria*) is a wetland plant native to Europe and Asia. In the United States, purple loosestrife invades marshes and lakeshores, replacing cattails and other wetland plants. The plant can form dense, impenetrable stands which are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals including ducks, geese, rails, bitterns, muskrats, frogs, toads, and turtles. The aggressive nature of this species has put many rare and endangered wetland plants and animals at risk.

Purple loosestrife thrives on disturbed, moist soils, often invading after some type of construction activity. Eradicating an established stand is difficult because of the enormous number of seeds the plant produces, often over 2 million seeds from a single adult plant annually. The plant is also able to re-sprout from its extensive underground root network, and from broken stems that fall onto the ground or in the water.

Key Characteristics of Purple loosestrife:

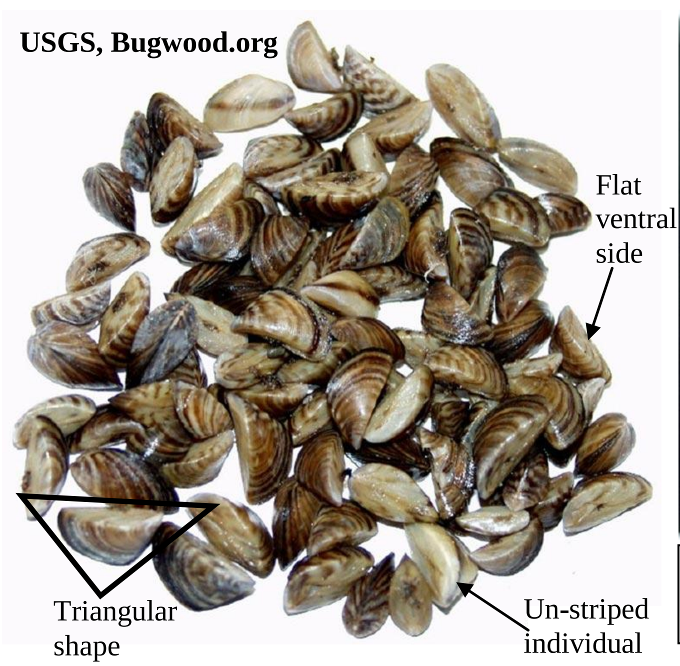
- Long, showy spikes of magenta flowers.
- Individual flowers with 5 to 7 petals.
- Flowers occur in dense clusters on terminal spikes.
- Flowers bloom from June to September.
- Leaves are downy (soft), with smooth edges.
- Leaves are usually arranged opposite each other in pairs which alternate down the stalk at 90 degree angles, but they may appear in groups of three.
- Rootstock on mature plants is woody and extensive and can send out up to 30 to 50 shoots.

ZEBRA MUSSEL

Zebra mussels (*Dreissena polymorpha*) are small shellfish that are native to the Black, Caspian, and Azov Seas. Zebra mussels were introduced into North America in the mid 1980's via transoceanic ships that discharged ballast water into Lake St. Claire, near Detroit. Tolerant of a wide range of environmental conditions, zebra mussels have extended their range to parts of all the Great Lakes and the much of the Mississippi River, and are beginning to infest inland lakes as well.

A single zebra mussel female can produce in excess of 30,000 eggs, and the generations mature rapidly, making it difficult to control them. A body of water may have no detectable zebra mussels one year, and have its bottom covered with them the next. Zebra mussels cause a number of biological, recreational, and commercial problems that include:

- Removing plankton (tiny plants and animals) that serve as food for larval fish and native mussels. This disrupts the natural food chain and can cause severe damage to native species.
- Colonies of zebra mussels can suffocate native mussel beds.
- Clogging of water intake pipes for water treatment and power plants.
- Dense growths of zebra mussels on breakwalls, locks and dams, control structures, and intake ports of water cooled engines are causing concern.
- Harm to the spawning success of reef-spawning fish and reduced commercial fish catches.
- Attachment to boat docks and boat hulls and clogging of water intake ports on boat motors.
- Huge deposits of dead zebra mussels have been found on beaches and can cause foul odors and cut beach-goers feet due to their sharp shells.



This is a native Freshwater Mussel (Three-ridge) covered by Zebra mussels

Key Characteristics of Zebra Mussels:

- Most have a striped pattern on their shells.
- Triangular in shape.
- Sits flat on its ventral side.
- Typically found attached to objects, surfaces, or each other.
- SIZE: 1- 4 cm

MYSTERY SNAIL

Chinese mystery snails (*Cipangopaludina chinesis malleata*) are giant snails native to southeast Asia, eastern Russia, and Japan. This species was originally sold in the Chinese food market in San Francisco and likely was released from an aquarium in the 1930s. This species is relatively "benign" when compared to other aquatic invasive species. They do clog the screens of water intake pipes in some cases and also have the potential to transmit parasites and disease and interact negatively with native snails.

Chinese mystery snails feed on organic and inorganic bottom material, as well as benthic and epiphytic algae, mostly by scraping. The snails prefer slow-moving freshwater rivers, streams, and lakes with soft, muddy or silty bottoms.

Key Characteristics of Chinese Mystery Snails:

- SIZE. Chinese Mystery Snails are very big (around 2 inches) compared to native snails.
- Olive green, greenish brown, brown or reddish brown color as an adult.

RUSTY CRAYFISH

Rusty Crayfish (*Orconectes rusticus*) are a type of crayfish similar to those commonly found in Iowa, but they are native to the Ohio River basin. Rusty crayfish have probably been spread by non-resident fishermen who brought them as bait. Rusty crayfish are detrimental because they displace native crayfish, reduce the amount and kinds of aquatic plants, decrease the density and variety of invertebrates (animals lacking a backbone), and reduce some fish populations.

NOTE: Rusty crayfish are difficult to identify. Identification should be done by experts.

Key characteristics of the Rusty Crayfish:

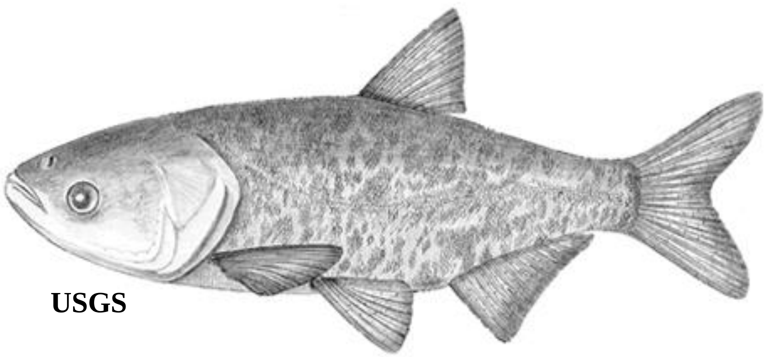
- Larger claws than native crayfish.
- Dark, rusty spots on either side of their carapace (not always present).

ASIAN CARP

Bighead carp (*Hypophthalmichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*) are two species of carp that are native to Asia. Both the bighead and the silver carp eat algae. The bighead carp were introduced into the Mississippi River when private hatchery ponds were flooded out in the state of Missouri. Once in the river, they quickly began spawning in the Mississippi and populations spread to other Iowa Rivers. These carp have also been found in the Chariton, Iowa, and Des Moines Rivers. The silver carp was introduced in Arkansas in 1973. It has not yet been found in Iowa, but it has been collected in Illinois, Missouri and throughout Arkansas.

Since bighead and silver carp eat microscopic food, it is feared they will also compete with young larval native fishes and mussels for food. They both can get quite large, with individuals over 60 lbs. having been collected. In addition, silver carp can jump up to 10 feet out of the water when disturbed by sounds of watercraft.

Bighead Carp

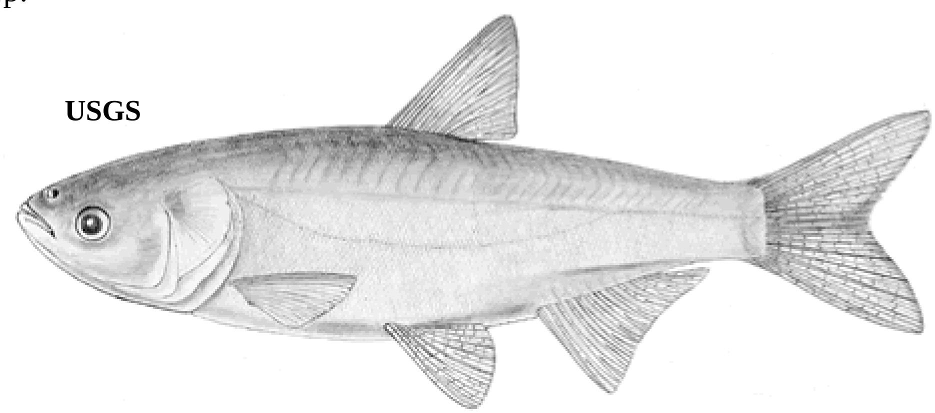


USGS

Characteristics of Bighead and Silver Carp:

- Low set eyes, below the mouth.
- Large upturned mouths without barbels.
- Small scales.

USGS



Silver Carp

Analyzing Biological Data

You Came, You Caught, and You Identified………..now what are you going to do with the data? The type and number of organisms that you collect depend on complex interrelationships among water quality, habitat quality, and food webs. Therefore it is difficult, if not altogether impossible, to draw meaningful conclusions from biological data alone. However, when combined with habitat and water quality data, biological data can be an essential tool in characterizing the quality of your stream.

Index of Biotic Integrity

One way to analyze biological data is to use an IBI, which stands for **I**ndex of **B**iotic **I**ntegrity. An IBI is a mathematical equation that combines individual measurements, or metrics, to obtain an estimate of stream health. IBI's are commonly calculated using professional data to determine the health of the biological community in a stream.

To improve analysis of volunteer-collected benthic data, a simplified Benthic Macroinvertebrate Index of Biotic Integrity (IBI) using the IOWATER tolerance groups of High, Middle, and Low Quality has been created. The High Quality (HQ) benthic macroinvertebrates were given a tolerance score of 3, the Middle Quality (MQ) a score of 2, and the Low Quality (LQ) a score of 1. For each site a metric is calculated by multiplying the number of individual benthic macroinvertebrates in each group by that group's tolerance score. These values are summed and then divided by the total number of individual benthic macroinvertebrates identified at the site. This metric can only be calculated at sites where benthic macroinvertebrates are found.

$$\text{IBI} = \frac{(\#HQ \times 3)+(\#MQ \times 2)+(\#LQ \times 1)}{\#HQ + \#MQ + \#LQ}$$

Sites with an IBI of <1.75 would indicate a poor benthic macroinvertebrate population and are likely dominated by benthic macroinvertebrates in the low quality tolerance group. High and middle quality benthic macroinvertebrates may be present, of course, but in small numbers.

Sites with IBIs ranging from 1.76 – 2.25 would indicate a fair benthic macroinvertebrate population and are likely dominated by benthic macroinvertebrates in the middle quality tolerance group. These sites may also have low and high quality benthic macroinvertebrates present.

Sites with IBIs ranging from >2.25 would indicate a good benthic macroinvertebrate population and are likely dominated by benthic macroinvertebrates in the high quality tolerance group. Benthic macroinvertebrates in the low and middle quality tolerance groups are likely to be present, but in smaller numbers.

Factors that Affect the Biological Community

Habitat – The places where organisms can live may be the single, most important factor influencing what lives in a stream or river. If there are limited suitable locations for organisms to live, the quality of the population will be reduced. Streams that offer diverse habitats (run, riffles, pools, and their associated microhabitats) create a variety of flow regimes and locations for organisms to live and escape predators.

Substrate – The type of habitat the stream provides have a significant impact on the IBI. Streambed substrates dominated by silt and sand generally have lower quality organisms than rock bottomed streams. Low IBIs at these sites don't necessarily indicate water quality issues, and may be more a function of habitat availability than stream pollution.

Depth and Velocity – Sensitive organisms tend prefer swifter moving water because it helps to keep oxygen levels high via atmospheric mixing. However, too much velocity can also pose a problem. When rain and runoff events generate deep, fast flows, the force of the water can dislodge and wash away organisms. Benthic macroinvertebrate populations in urban streams, which can be greatly impacted by stormwater runoff, may be susceptible to these "flashy" flows.

Season – Many invertebrates are insect larva and emerge at varying times of the year. For example, ,if you monitor when the organisms have completed their metamorphosis and flew away from the stream as adults, the IBI scores may indicate lower quality than what is truly represented throughout the year.

Water Temperature – Very warm streams typically do not hold as much dissolved oxygen as cooler streams. Streams that are influenced by springs, such as those in the northeast portion of the state, have colder water tend to support many different types of organisms.

Flow – Invertebrates must have a fairly consistent amount of water to survive. Intermittent streams that dry up occasionally may not be able to support the same population of macroinvertebrates that perennial streams can.

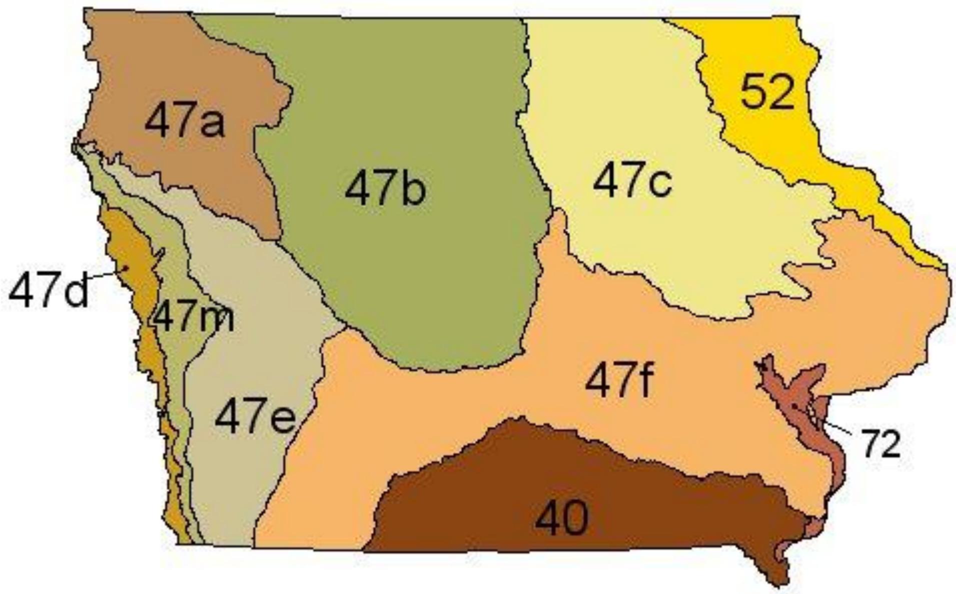
Water Chemistry – A balance of chemical conditions must be maintained to support diverse aquatic life. Imbalances, such as high levels of nutrients, can alter the stream by causing high levels of algae and plant growth, which can in turn cause decreased dissolved oxygen levels when these plants decompose. Also, certain chemicals, such as pesticides, are toxic to organisms and can kill or damage aquatic life.

General Identification to Order – When professional biologists evaluate macroinvertebrates, they identify them to genus and species. This is a difficult and time-consuming process, but allows for analysis of data that can provide very fine discriminations between stream health classifications because individual species in an order can vary greatly in their tolerance to pollution. Because IOWATER volunteers only identify insects to the Order level, these ratings are not as accurate, but may still provide valuable baseline information.

Ecoregions - Biological data differ depending on where you are located in the state. One way to look at the variation across the state is to break down the state into ecological regions (ecoregions), which are areas in which there are similarities in biological systems and relationships between organisms and their environment (Griffith 1994). Ecoregions were delineated in the late 1980's (Omernik 1987) to provide a geographic framework for more efficient management of ecosystems and their components. This concept recognizes that land features such as bedrock geology, topography, soil type, vegetation, land use and human impacts interact to form specific ecological regions or ecoregions. The relative importance of individual factors and the complexity with which these factors interact varies from one ecoregion to another.

Ecoregions can be recognized and defined at different scales to suit a variety of purposes (Omernik 1995). Omernik's Level III ecoregion delineations (1987) created 4 ecoregions in Iowa: the Western Corn Belt Plains (47), the Central Irregular Plains (40), the Driftless Area (52) and the Interior River Lowland (72). In 1993, the U.S. EPA and IDNR completed an ecoregion refinement project to facilitate biocriteria development (U.S. EPA 1993). This project further refined the ecoregions in Iowa. Currently there are 10 Level IV ecoregions or subecoregions within the state of Iowa.

Level IV Ecoregions of Iowa.



Below is a discussion of the general characteristics of each ecoregion:

- 40-- Loess Flats and Till Plains
  - Deep to moderate loess deposits over glacial till and dark, shallow soils are characteristic of the Loess Flats and Till Plains ecoregion. Loess deposits generally increase to the south, especially near the Missouri River. Several streams have headwaters in this region, and the topography varies from flat to moderately hilly. Valley sides are not steep, with slopes generally less than 10%. The Chariton River area is a more dissected and hilly area within this region. It lacks glacial till in many places and has a greater drainage density and more woody vegetation in stream reaches than in other parts of the ecoregion. Natural wetlands occur along the Grand River and several other rivers in the region. Soils are inherently fertile, but use can be limited due to severe erosion. Land use includes areas of cropland, pasture in the valleys and on upland slopes, and bands of woodland. Corn and soybeans are the major crops.
- 47a-- Northwest Iowa Loess Prairies
  - The Northwest Iowa Loess Prairies ecoregion is a gently undulating plain with a moderate to thick layer of loess. It is the highest and driest region of the Western Corn Belt Plains, as it rises to meet the Northern Glaciated Plains of the Dakotas. Although loess covers almost all of the broad upland flats, ridges, and slopes, minor glacial till outcrops occur near the base of some of the side slopes. Silty clay loam soils have developed on the loess. The area is mostly treeless, except for the more moist areas along some stream corridors and on farmstead windbreaks. The dominant land use is cropland agriculture with some pasture and cattle feedlots.
- 47b-- Des Moines Lobe
  - One of the youngest and flattest regions in Iowa, the Des Moines Lobe ecoregion is a distinctive area of Wisconsinan glacial stage landforms currently under extensive agriculture. In general, the land is level to gently rolling with some areas of the moraines having the most relief. The morainal ridges and hummocky knob and kettle topography contrast with the flat plains of ground moraines, former glacial lakes, and outwash deposits. A distinguishing characteristic from other parts of Ecoregion 47 is the lack of loess over the glacial drift. The stream network is poorly developed and widely spaced. The major rivers have carved valleys that are relatively deep and steep-sided. Almost all of the natural lakes of Iowa are found in the northern part of this region. Most of the region has been converted from wet prairie to

agricultural use with substantial surface water drainage. Only a small fraction of the wetlands remain, and many natural lakes have been drained as a result of agricultural drainage projects.

- 47c-- Iowan Surface
    - The Iowan Surface ecoregion is a geologically complex region located between the bedrock-dominated landforms of the Paleozoic Plateau region and the relatively recent glacial drift landforms of the Des Moines Lobe. The southern and southeastern border of this ecoregion is irregular and crossed by major northwest- to southeast-trending stream valleys. In the northern portion of the region, the glacial deposits are thin, and shallow limestone bedrock creates karst features such as sinkholes and sags. There are no natural lakes of glacial origin in this region, but overflow areas and backwater ponds occur on some of the larger river channels contributing to some diversity of aquatic habitat and a large number of fish species.
- 47d-- Missouri Alluvial Plain
    - The Missouri Alluvial Plain is part of the large, wide, flat alluvial plain found in five neighboring states. Surrounded by bluffs capped with deep loess, the historic island-studded meandering river channel has been stabilized and narrowed to manage discharge and to promote navigation and agriculture. The deep silty and clayey alluvial soils support extensive cropland agriculture. Most of the oak-hickory forest, floodplain forest, and tallgrass prairie has been removed due to conversion to cropland, although some wetlands are being restored.
- 47e-- Steeply Rolling Prairies
    - Rolling hills with thick loess deposits and underlying glacial till distinguish the Steeply Rolling Loess Prairies ecoregion from the flat Missouri Alluvial Plain to the west. Land clearing has promoted vast sheet erosion and gullying and consequent re-deposition of loess in the valley bottoms. Potential natural vegetation is tallgrass prairie with woodland in narrow valleys and stream reaches. Most of the region is prime farmland and cropland is extensive.
- 47f-- Rolling Loess Prairies
    - Loess deposits on well drained plains and open low hills characterize the Rolling Loess Prairies ecoregion. Loess deposits tend to be thinner than those find in the Steeply Rolling Loess Prairies to the west, generally less than 25 feet in depth except along the Missouri River where deposits are thicker. Potential natural vegetation is a mosaic of mostly tallgrass prairie and areas of oak-hickory forest. Although cropland agriculture is widespread, this region has more areas of woodland and pasture than the areas to the west.
- 47m-- Western Loess Hills
    - The Western Loess Hills ecoregion extends south from Iowa and covers only a small area in northwestern Missouri. The deep loess-dominated hills have greater relief and a higher drainage density than the Steeply Rolling Loess Prairies to the east. The more irregular topography and erosive, silty soils contributed to a mixed land use with less cropland and more pasture and woodland than neighboring regions. The flora of this region is mixed, with shortgrass and mixed-grass prairie and rare xeric species on south and west-facing slopes, and bur-oak woodland and tallgrass prairie on cooler, moister slopes.
- 52-- Paleozoic Plateau
    - The bedrock-dominated terrain of the Paleozoic Plateau ecoregion is strikingly different from the rest of Iowa. Steep slopes and bluffs, higher relief, sedimentary rock outcrops, dense forests, and unique boreal microhabitats differentiate this ecoregion from the Western Cornbelt Plains to the west. The Silurian Escarpment, a prominent physiographic feature that helps define the southern and western boundary this ecoregion, separates the mostly cropland area of the west from the mixed land use of the Driftless Area. Dissolution of the limestone and dolomite rocks results in karst features such as sinkholes, caves, and springs, and makes groundwater vulnerable to contamination. The streams in the Iowa portion of this region occupy entrenched valleys, and have cool waters with high gradients flowing over rocky

substrates. The fish communities found here reflect this preference for cool clear water with relative consistency of flow.

- 72-- Interior River Lowland
    - A small portion of the Upper Mississippi Alluvial Plain is found in Missouri, with most of the ecoregion occurring in Illinois and Iowa. The smooth to irregular alluvial plain and the river channel have undergone drastic changes in the last 100 years. Large reaches of the river have been channelized and numerous low dams with locks have been constructed upstream of St. Louis. The potential natural vegetation of oak-hickory forest, northern floodplain forest, and tallgrass prairie has all but been replaced by agriculture. Soils are deep, silty, and clayey alluvium and support extensive cropland. The Mississippi River is generally less turbid than in the Missouri portions of the region.

Summary of Analyzing Invertebrate Data

Remember, it is important to collect data over an extended period of time to accurately characterize your site. A <u>*maximum*</u> of 3 macroinvertebrate samples can be collected per sampling season. The time you spend collecting and the number of different habitats that you sample will affect the number and type of macroinvertebrates that you find. In general, if you sample for a longer time period, you should find a greater number of organisms. Also, if you sample more habitat types, you should find a greater variety of organisms as well. The table below contains general guidelines of the analysis you can gain from your macroinvertebrate sampling.

OBSERVATION	ANALYSIS
High diversity, high density, many sensitive species	No problems; good water quality
High diversity, low density of species present	Possible poor habitat conditions
Low diversity, high density of species present	Nutrient enrichment or sedimentation possible; excessive algal growth due to nutrient enrichment
Low diversity, low density or no macroinvertebrates but the stream *looks* clean	Possible toxic inputs; unproductive

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Glossary

Abdomen: The posterior section of the body behind the thorax.
Abdominal segment: one of the parts of the abdomen that is divided or marked off by natural boundaries
Amphipoda: the class that scuds or "freshwater shrimp" are a member of
Antennae: one of a pair of slender movable sensory organs on the head of insects and crustaceans
Baseline: A level or concentration that is the norm.
Beetle: any of an order (Coleoptera) of insects having four wings of which the outer pair are modified into stiff plates that protect the inner pair when at rest
Benthic: describes all things associated with the bottom, or substrate of a stream
Benthic Macroinvertebrates: Bottom-dwelling organisms that lack a backbone, inhabit streams or lakes, and can be seen with the naked eye.
Benthic: Describes all things associated with the bottom, or substrate of a stream.
Biodiversity: The diversity of plant and animal life in a particular habitat.
Biotic Index: A numerical value that describes the biological integrity of aquatic communities for a water body.
Breathing tube: a structure extending from the body used to breathe while underwater
Case: an outer covering or housing
Chitin: A tough, protective, semitransparent substance, primarily a nitrogen-containing protein, forming the principal component of arthropod exoskeletons and the cell walls of certain fungi.
Cilia: A microscopic hair-like appendage extending, capable of rhythmical motion, it acts in unison with other such structures for movement.
Clam/mussel: the common name for a number of species of bivalve mollusks
Class: a major category in biological taxonomy ranking above the order and below the phylum or division
Claw: any of various sharp curved appendages especially at the end of a limb
Club-like: a heavy, usually tapering appendage
Compound eyes: The eye of most insects and some crustaceans, which is composed of many light-sensitive elements, each having its own refractive system and each forming a portion of an image.
Crustacean: Animals of the Subphylum Crustacea; have no discernible metamorphosis; two pairs of antennae; have an exoskeleton composed of chitin; have specialized segmented appendages; the thorax or cephalothorax has five to eight appendages; the abdomen has six pairs of appendages; appendages are usually biramous.
Decapoda: The class that crayfish are a member of.
Disc-like: a body part shaped like a thin circular object
Divergent: differing from each other or from a norm
Diverse: Having a large variety of organisms.
Dorso-ventrally Flattened: The body is wider than it is high.
Exoskeleton - an external supportive covering of an animal
Family: A group of related plants or animals forming a category ranking above a genus and below an order
Filament: a single thread or a thin flexible threadlike object, process, or appendage
Filamentous: having multiple filaments
Flatworm: Animals of the Class Turbellaria; free-living; do not undergo metamorphosis with soft, elongate, flattened body; unsegmented; head resembles a triangle and has no appendages.
Fleshy lobes: appendages or objects resembling flesh
Foreleg: a front leg
Gill: an organ for obtaining oxygen from water
Hind leg: a rear leg
Hirudinea: The class that leeches are a member of.
Indicator Species: Groups or types of organisms used to assess the environmental health of a water body.
Insect: Any of a class of arthropods with well-defined head, thorax, and abdomen, only three pairs of legs, and typically one or two pairs of wings.

Invertebrate: An organism without a backbone.
Isopoda: The class that sowbugs are a member of.
Lateral filament: a single thread or a thin flexible threadlike object, process, or appendage situated on, directed toward, or coming from the side
Laterally compressed: Body part is wider than it is tall.
Left spiral snail: the most common snail type found in Iowa; opening of the shell is toward the left when viewed with the tip of the shell pointing up; a pollution tolerant group
Macroinvertebrate: An animal large enough to see that does not have a backbone.
Malacostracans: Exhibit the hard, calcified exoskeleton typical of crustaceans.
Mollusk: Animals of the Phylum Mollusca, snails, clams and mussels, have a hard shell which the body can be enclosed in.
Oligochaeta: The class that aquatic earthworms are a member of.
Order: A category of taxonomic classification ranking above the family and below the class.
Phylum: One of the primary divisions of the animal kingdom.
Physidae: The family that left spiral snails are a member of.
Plate: a lamina or plaque that forms an armor of such on a part of an animal body
Pollution Sensitive Organisms: Organisms that cannot withstand the addition of pollution to their aquatic environment.
Pollution Tolerant Organisms: Organisms that can withstand polluted environments.
Pollution: An undesirable change in the environment, usually the introduction of abnormally high concentrations of hazardous or detrimental substances, such as nutrients or sediment. The presence of any substance that harms the environment.
Portable case: an outer covering or housing capable of being carried or moved about
Proleg: a fleshy leg that occurs on an abdominal segment of some insect larvae but not in the adult
Representative: Is typical or a characteristic example.
Riffle: That portion of a stream that is shallow and fast moving. An area of the stream where shallow water flows swiftly over completely or partially submerged rocks or other debris.
Right spiral snail: a type of pollution sensitive snail, opening of shell is facing the right when viewed with the tip of the shell pointing up
Segmented: divided or marked off by natural boundaries
Segmented leg: a leg that is divided or marked off by natural boundaries
Spine: sharp, rigid, thorn-like extension on an animal
Streamlined: contoured to reduce resistance to motion through a fluid
Sucker: a mouth that various animals have for adhering or holding
Suction pad: an organ on a leech used for adhering or holding
Swimming hairs: Long, threadlike appendages that assist with movement.
Tarsal claw: a sharp, curved, cartilage appendage on the 1^{st} pair of legs on a crustacean
Taxa: A group of organisms based on biological classifications.
Thorax: The second or middle region of the body, between the head and the abdomen, in insects bearing the true legs and wings.
Tolerant Species: An organism that can exist in the presence of a certain degree of pollution.
True bug: Insects of the order Hemiptera, these insects are mostly predators, swim with oar-like hind legs or can walk on water by surface tension, usually breath by the means of an air store, and have prominent eyes.
Tubellaria: The class that flatworms are a member of.
Unsegmented: a body part not divided by natural boundaries
Walking legs: The legs of an arthropod or insect that are used for motion.
Wing pads: a developing wing and its encasement
Worms: The common name for members of the Annelid phylum that are elongated, naked, soft-bodied animals resembling an earthworm.

IOWATER

Volunteer Water Quality Monitoring

Biological Assessment

*** Recommended frequency – no more than 3 times a year, preferably between mid-July to mid-Oct***

Date Aug 12, 2009 **Time** 3 PM

IOWATER Monitor J. Gautsch **# of Adults (incl. you)** 2

Site Number 969601-Little Creek #1 **# of under 18** Ø

Other Volunteers Involved L. Fascher

Was the stream dry when it was monitored? Yes _____ **No** X

Y **Were Benthic Macroinvertebrates Found?** (*If no, please provide any relevant comments in the "Other Assessment Observations and Notes" section at the end of this form*)

Benthic Macroinvertebrates (*record the number of each collected, then total each group*)

High Quality Group (*pollution intolerant*)

Tally Column	Total # found	HQ BMI
	15	Caddisfly
	2	Dobsonfly
	6	Mayfly
	4	Riffle Beetle
	Ø	Snail (not pouch)
	8	Stonefly
	Ø	Water Penny Beetle
TOTAL	35	(A)

Middle Quality Group (*somewhat pollution tolerant*)

Tally Column	Total # found	MQ BMI
	Ø	Alderfly
	Ø	Backswimmer
	3	Crane Fly
	6	Crawdad
	Ø	Crawling Water Beetle
	Ø	Damselfly
	Ø	Dragonfly
	Ø	Giant Water Bug
	Ø	Limpet
	Ø	Mussels/Clams
	Ø	Orbsnail
	11	Predaceous Diving Beetle
	Ø	Scud
	Ø	Sowbug
	Ø	Water Boatman
	1Ø	Water Mite
	Ø	Water Scorpion
	13	Water Strider
	Ø	Whirligig Beetle
TOTAL	43	(B)

Low Quality Group (*pollution tolerant*)

Tally Column	Total # found	LQ BMI
	Ø	Aquatic Worm
	6	Black Fly
	Ø	Bloodworm
	1Ø	Flatworm
	Ø	Leech
	Ø	Midge Fly
	Ø	Mosquito
	Ø	Pouch Snail
	Ø	Rat-tailed Maggot
	Ø	Water Scavenger Beetle
TOTAL	16	(C)

___ **Other** ________________ **(no tolerance group assigned)**

Index of Biotic Integrity (IBI) = $\frac{(AX3)+(BX2)+(CX1)}{A+B+C}$ = 2.2Ø

$\frac{(35\times3)+(43\times2)+(16\times1)}{35+43+16} = \frac{105+86+16}{94} = \frac{207}{94} = 2.20$

(Over)

Revised March 2010

Benthic Macroinvertebrate Collection Time *(check one)*
0-15 min. _____ **15-30 min.** _____ **30-45 min.** _X_ **More than 45 min.** _____

Collection Nets *(How many nets are you using to collect critters?)*
1 ____ **2** _X_ **3** ____ **4** ____ **5** ____ **6+** ___

Identification Confidence Level *(Are you confident that your identification is correct?)*
_____ **I'm not sure**
_____ **I think they've been identified correctly**
_____ **Some are definitely correct, I'm not sure about others** *(Please clarify in "Other Assessment Observations and Notes" section at the end of this form)*
_____ **I'm fairly confident they've all been correctly identified**
_X_ **I guarantee they have been identified correctly**

Stream Reach Length *(How far along the stream did you search?)*
___ **0-25 meters** _X_ **25-50 meters** ___ **50-75 meters** ___ **75-100 meters** ___ **100+ meters**

Microhabitats *(check all present in stream reach, check if sampled)*

Algae Mats	Present X	Sampled X	**Leaf Packs**	Present X	Sampled X
Logjams	Present X	Sampled X	**Rocks**	Present X	Sampled X
Root Wads	Present __	Sampled __	**Weed Beds**	Present __	Sampled __
Fallen Trees	Present X	Sampled X	**Undercut Banks**	Present __	Sampled __
Silt/Muck	Present __	Sampled __	**Rip Rap**	Present __	Sampled __
Sand	Present __	Sampled __	**Overhanging Vegetation**	Present __	Sampled __

Junk *(tires, garbage, etc.)* Present __ Sampled __
Other *(describe)* ______________________ Present __ Sampled __

Stream Habitat Type *(check all types sampled in stream reach)*
Riffle _X_ **Run** _X_ **Pool** _____

Aquatic Plant Cover of Streambed *(at transect – check one)*
0-25% _____ **25-50%** _____ **50-75%** _____ **75-100%** _____

Algae Cover of Stream Streambed *(at transect – check one)*
0-25% _X_ **25-50%** _____ **50-75%** _____ **75-100%** _____

Is sewage algae present in the stream?
No _X_ **Yes** _____ *If yes, please submit a photographic record & contact IOWATER.*

Invasive Species *(check all found)*
___ **Eurasian water milfoil** ___ **Curly-leaf pondweed** ___ **Zebra mussels**
___ **Brittle naiad** ___ **Purple Loosestrife** ___ **Chinese mystery snails**
___ **Bighead Carp** ___ **Silver Carp** ___ **Rusty Crawfish**

Other Assessment Observations and Notes
Very nice streamsite, many BMIs found. Water is clear and substrate is free of silt and other fine materials, lots of habitats & microhabitats for BMIs. Also saw darters and minnows.

Revised March 2010